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Tables and Equations for Estimating Volumes of Trees in the Susitna River Basin, Alaska

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Abstract

Scribner board-foot, merchantable cubic-foot, and total cubic-foot volume equations were derived from fall, buck, and scale data for 441 trees at 78 locations in the Susitna River basin, Alaska. Tree species included white and black spruce, paper birch, black cottonwood, and quaking aspen.

Keywords: Volume tables, volume equations, white spruce, black spruce, paper birch, black cottonwood, quaking aspen, Susitna River basin, Alaska.

Introduction

Scribner board-foot, merchantable cubic-foot, and total cubic-foot volume equations were derived from an analysis of fall, buck, and scale data obtained during a multi-resource inventory of the Susitna River basin, Alaska (USDA, Soil Conservation Service 1986). Board-foot volumes are presented for combinations of diameter at breast height (dbh) and total tree height and for dbh and height to a 6-inch top. Merchantable cubic-foot volumes are presented for combinations of dbh and total tree height, and for dbh and height to a 4-inch top. Total cubic-foot volumes are given for dbh and total tree height only.

A total of 441 trees were used in the analysis: 244 white spruce *(Picea glauca* (Moench) Voss), 43 black spruce (P. *mariana* (Mill.) B.S.P.), 97 paper birch *(Betula papyifera* Marsh.), 14 quaking aspen *(Populus tremuloides* Michx.), and 43 black cottonwood (P. *trichocarpa* Torr. & Gray). Data were collected from 78 locations in the Susitna River basin, which is roughly bounded by the Alaska Range to the north and west, the Talkeetna Mountains to the east, and Cook Inlet and Knik Arm to the south (fig-1).

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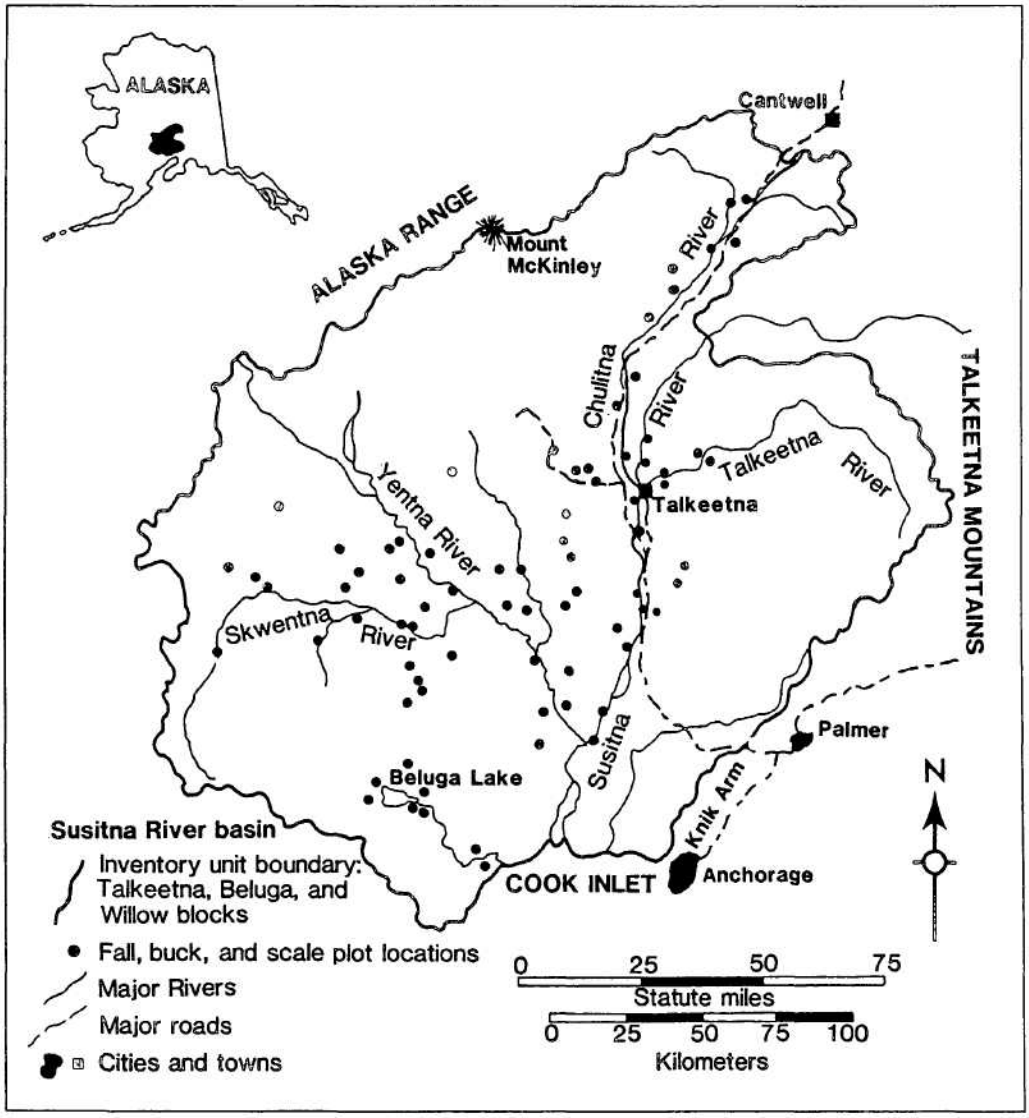

Figure 1—Part of the Susitna River basin, Alaska, where fall, buck, and scale data were collected.

Methodology

Fall, buck, and scale sample trees were selected by using a 40-basal-area factor prism rotated about points located 200 feet north of point 3; east of points 4, 5, and 6; south of point 7; and west of points 8, 9, and 10 of the forest survey 10-point inventory plots. Al! tally trees greater than 5 inches dbh were destructively sampled. Each sample tree was measured and marked at a 1-foot stump and at dbh. After felling and limbing, total height and height to a 6-inph and a 4-inch top were recorded. The tree was bucked into 16.3-fo6t logs and at 6-inch and 4-inch tops. All cross-sectional diameters inside bark were measured twice at right angles and averaged.

Data from trees suitable for volume-table construction were used to build a data file consisting of dbh, total height, height to 4-inch and 6-inch tops, total and merchantable cubic-foot volume, and Scribner board-foot volume. Trees with missing data, or data obviously in error, were eliminated from the data base as were obviously deformed and cull trees. All merchantable portions of forked trees were included. Tree data were then examined to assure that the bucking was consistent with USDA, Forest Service log scaling rules.[1] If a log was too short or too long, a portion of the next log was "added" or the log was "cut" to a standard length and a new diameter was calculated; it was assumed that logs were circular in cross section with linear taper between the existing end measurements. Board-foot volumes were not computed for pieces shorter than 8 feet or if diameter inside bark at the small end was less than 6 inches. Cubic-foot volumes were computed using Smalian's formula. Board-foot volumes, Scribner rule, were computed by using the Girard and Bruce rule of thumb (Dilworth 1968):

$$\text{volume} = (0.79 \times \text{diameter}^2 - 2.0 \times \text{diameter} - 4.0) \times (\text{length}/16.0) .$$

Plottings of volume over dbh^2 x height indicated that cubic-foot volume was linearly related to dbh^2 x height and board-foot volume was curvilinearly related to dbh^2 x height. The independent variables tested therefore included dbh, dbh^2, height (ht), dbh^2.x.ht, 1/dbh, $1/dbh^2$, and $(dbh^2ht)^c$.

Regression portions of the SPSS^X statistical program package (SPSS 1983)[2] were used to run forward-stepwise analysis for linear expressions of the data. The term $(dbh^2ht)^c$ was fitted after transformation with logarithms; for example, $\ln(BFV) = b_0 + {}_1 \times \ln(dbh^2ht)$. Both weighted and unweighted linear regressions were tested as described by Furnival (1961) with various results. The logarithm transformation to obtain an equation with $(dbh^2ht)^c$ avoids the need of weights because it assumes that the residuals are distributed normally about a log normal distribution function.

Analysis of covariance was used to test for significant differences in the data between white and black spruce and between paper birch and quaking aspen. In both cases, the data were not significantly different and therefore were pooled.

Discussion

The regression equation for each table is presented at the bottom of the table; it is followed by the increased efficiency of the equation used over the unweighted linear model, where volume = a + b(dbh ht). The standard error of the estimate is also presented. The shading in the tables indicates the limits of the data. The number of trees in each diameter class by species is also presented.

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[1] Unpublished manual, 1981, "Forest Service Manual, title 2400, Timber Management, Alaska Region Supplement 228," by U.S. Department of Agriculture, Forest Service, Alaska Region, Juneau, Alaska 99802.

[2] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

Board-foot volumes for most species were lower than shown in all published tables (Dippold and Farr 1971, Farr 1967, Gregory and Haack 1964, Haack 1963, Kerr and Eleazer 1980) and unpublished tables[3] for small-diameter classes. Greater board-foot volumes are reported for spruce trees larger than 24 inches dbh in all published tables except the Tyonek tables (Kerr and Eleazer 1980). The Tyonek tables show that spruce volume is less than the volumes published in this report after the spruce reach 10 inches dbh. Board-foot volumes for birch and aspen exceed published values when trees exceed 16-18 inches dbh except in the Tyonek tables where, like the spruce, more volume is reported at 10 inches dbh and above. Volumes for black cottonwood were higher in lower classes, below 17 inches dbh, than are reported for balsam poplar (Haack 1963) but slightly higher than Ryan's data for very large classes (see footnote 3).

In our tables, board-foot volumes for trees whose height was measured to a merchantable 6-inch top diameter were lower than Ryan's (see footnote 3) for white and black spruce, lower than Ryan's for paper birch and quaking aspen less than 12 inches dbh, and lower than Ryan's for black cottonwood less than 19 inches dbh.

Our spruce merchantable cubic-foot volumes (that is, volumes to a 4-inch top diameter inside bark [dib]) were nearly identical to those reported by Gregory and Haack (1964) and Ryan (see footnote 3), and only slightly lower in large-diameter classes than those reported by Haack (1963) and Dippold and Farr (1971). Merchantable cubic-foot volumes were greater than those reported by Kerr and Eleazer (1980) for white and black spruce, birch, and aspen greater than 11 inches dbh. Birch and aspen merchantable cubic-foot volumes were greater than those reported for Tyonek (Kerr and Eleazer 1980) but, otherwise, not much different than those reported by others cited. Black cottonwood merchantable cubic-foot volumes were nearly identical to other reported data for this species except as reported by Gregory and Haack (1964) for black cottonwood and balsam poplar *{Populus balsamifera* L.) where reported volumes are greater in diameter classes above 16-17 inches dbh. Poplar and cottonwood were combined by Gregory and Haack.

Merchantable cubic-foot volumes in tables for tree heights measured to a merchantable 4-inch top diameter inside bark were nearly identical to Ryan's (see footnote 3) for spruce, birch, and aspen and only slightly lower than those for black cottonwood in large-diameter classes.

Total cubic-foot volumes of the entire stem for spruce, paper birch and quaking aspen were nearly equal to those reported by Gregory and Haack (1964) for small-size classes but were slightly lower for larger classes. The total cubic-foot volume of black cottonwood was slightly higher in our tables than in those of Gregory and Haack (1964).

[3] Unpublished office report, 1984, "Volume tables for the Susitna River valley, Alaska," by Phyllis Ryan, State of Alaska, Department of Natural Resources, 3601 C. Street, Anchorage, Alaska 99503.

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Table 1- Board-foot volumes, Scribner line (1-foot stump to 6-inch top dib) given dbh and total height for white spruce and black spruce, Susitna River basin, Alaska[a]

DBH (d)[b]	Total height in feet (h)[c]															Trees measured[d]	
	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	White spruce	Black spruce
Inches	Board-foot volume															--Number--	
6	2.5	3.1	3.7	4.3	5.0	5.8	6.5	7.3	8.1							1	1
7	3.8	4.7	5.7	6.7	7.8	8.9	10.0	11.2	12.4	13.7	15.0					4	2
8	5.5	6.8	8.3	9.7	11.3	12.9	14.6	16.3	18.1	19.9	21.8					23	8
9	7.7	9.5	11.5	13.6	15.7	18.0	20.3	22.7	25.2	27.8	30.4					40	5
10	10.3	12.8	15.4	18.2	21.1	24.1	27.3	30.5	33.9	37.3	40.8					34	3
11	13.5	16.7	20.2	23.8	27.6	31.5	35.6	39.9	44.2	48.7	53.4	58.1				22	4
12	17.2	21.4	25.8	30.4	35.2	40.3	45.5	50.9	56.5	62.2	68.1	74.2	80.4	86.7		31	1
13	21.5	26.7	32.2	38.0	44.1	50.4	57.0	63.7	70.7	77.9	85.3	92.9	100.6	108.5		14	2
14	26.5	32.9	39.7	46.8	54.3	62.1	70.1	78.5	87.1	95.9	105.0	114.3	123.9	133.6		14	1
15	32.2	39.9	48.2	56.8	65.9	75.3	85.1	95.2	105.7	116.4	127.4	138.8	150.3	162.2		8	
16	38.6	47.9	57.7	68.1	79.0	90.3	102.0	114.1	126.6	139.5	152.7	166.3	180.2	194.4	208.9	8	
17	45.7	56.8	68.5	80.8	93.6	107.0	120.9	135.3	150.1	165.4	181.1	197.2	213.6	230.5	247.7	4	
18			80.4	94.8	109.9	125.7	142.0	158.9	176.3	194.2	212.6	231.5	250.8	270.6	290.8	4	
19					127.9	146.2	165.2	184.9	205.1	226.0	247.4	269.4	291.9	314.9	338.4		
20						168.9	190.8	213.5	236.9	261.0	285.7	311.1	337.1	363.7	390.8		
21							218.8	244.8	271.7	299.3	327.7	356.8	386.6	417.1	448.2		
22								279.0	309.6	341.1	373.4	406.5	440.5	475.2	510.7		
23									350.7	386.4	423.0	460.6	499.0	538.4	578.6		
24									395.2	435.4	476.7	519.0	562.4	606.7	652.0		
25									443.2	488.3	534.5	582.2	630.6	680.3	731.1	1	
26									494.8	545.1	596.7	649.7	704.0	759.5	816.2		
27									550.1	606.0	663.4	722.3	782.7	844.4	907.4		
															Total	208	27

[a] Regression: BFV = 0.000136 $(d^2h)^{1.40338}$; increased efficiency = 184 percent; standard error of estimate = 8.5 board feet or 21 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data is shaded. Includes 208 white spruce and 27 black spruce

Table 2—Board-foot volumes, Scribner rule (1-foot stump to 6-inch top dib) given dbh and total height for paper birch and quaking aspen, Susitna River basin, Alaska[a]

DBH (d)[b]	Total height in feet (h)[c]												Trees measured[d]	
	25	30	35	40	45	50	55	60	65	70	75	80	Paper birch	Quaking aspen
Inches	Board-foot volume												--Number--	
6	2.0	2.6	3.2	4.0	4.7	5.5	6.3	7.2	8.1	9.1	10.1		1	
7	3.1	4.1	5.1	6.3	7.4	8.7	10.0	11.4	12.9	14.4	15.9		4	1
8	4.6	6.1	7.6	9.3	11.1	12.9	14.9	17.0	19.1	21.3	23.6		14	4
9	6.6	8.6	10.8	13.2	15.7	18.4	21.2	24.1	27.1	30.3	33.5		5	2
10	9.0	11.8	14.8	18.0	21.5	25.1	28.9	32.9	37.1	41.4	45.9	50.5	16	
11	11.9	15.6	19.6	23.9	28.5	33.3	38.4	43.7	49.2	54.9	60.9	67.0	12	2
12	15.4	20.2	25.4	31.0	36.9	43.2	49.7	56.6	63.7	71.1	78.8	86.7	14	3
13		25.6	32.2	39.3	46.8	54.7	63.1	71.7	80.8	90.2	99.9	110.0	7	1
14			40.2	49.0	58.3	68.2	78.6	89.4	100.7	112.4	124.5	137.0	3	
15				60.1	71.6	83.7	96.4	109.7	123.6	138.0	152.8	168.2	4	
16				72.8	86.7	101.4	116.8	132.9	149.7	167.1	185.1	203.7		
17					103.8	121.4	139.8	159.1	179.2	200.0	221.6	243.9	2	
18					123.0	143.8	165.7	188.6	212.3	237.0	262.6	289.0	1	
19					144.4	168.9	194.6	221.4	249.3	278.3	308.3	339.3		
20					168.2	196.7	226.6	257.8	290.3	324.1	359.1	395.2	1	
21								298.0	335.6	374.6	415.0	456.8		
22								342.1	385.3	430.1	476.5	524.4		
											Total		84	13

[a] Regression: $BFV = 0.000081 * (d^2h)^{1.48459}$; increased efficiency = 108 percent; standard error of estimate = 11.0 board feet or 24 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data is shaded. Includes 84 paper birch and 13 quaking aspen.

Table 3—Board-foot volume, Scribner rule (1-foot stump to 6-inch top dib) given dbh and total height for black cottonwood, Susitna River basin, Alaska[8]

DBH (d)[b]	Total height in feet (h)[c]															Trees measured[d]
	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Black Cottonwood
Inches	Board-foot volume															--Number--
7					1.8	4.1	6.4	8.7	11.0	13.3	15.5	17.8	20.1			1
8		1.9	4.9	7.9	10.9	13.9	16.9	19.9	22.9	25.9	28.9	31.9	34.9			4
9	6.1	9.9	13.7	17.5	21.3	25.1	28.9	32.7	36.4	40.2	44.0	47.8	51.6			1
10	14.1	18.8	23.5	28.2	32.8	37.5	42.2	46.9	51.6	56.3	60.9	65.6	70.3			1
11	23.0	28.6	34.3	40.0	45.6	51.3	57.0	62.6	68.3	74.0	79.6	85.3	91.0			7
12	32.7	39.4	46.1	52.9	59.6	66.4	73.1	79.9	86.6	93.4	100.1	106.9	113.6			2
13	43.2	51.1	59.0	66.9	74.9	82.8	90.7	98.6	106.5	114.5	122.4	130.3	138.2	146.1	154.0	
14	54.6	63.8	72.9	82.1	91.3	100.5	109.7	118.9	128.0	137.2	146.4	155.6	164.8	173.9	183.1	3
15	66.8	77.3	87.9	98.4	109.0	119.5	130.1	140.6	151.1	161.7	172.2	182.8	193.3	203.8	214.4	6
16	79.9	91.9	103.9	115.9	127.8	139.8	151.8	163.8	175.8	187.8	199.8	211.8	223.8	235.8	247.8	2
17	93.8	107.3	120.9	134.4	147.9	161.5	175.0	188.6	202.1	215.6	229.2	242.7	256.3	269.8	283.3	4
18				154.1	169.3	184.4	199.6	214.8	230.0	245.2	260.3	275.5	290.7	305.9	321.1	2
19					191.8	208.7	225.6	242.5	259.5	276.4	293.3	310.2	327.1	344.0	360.9	2
20					215.6	234.3	253.0	271.8	290.5	309.3	328.0	346.7	365.5	384.2	403.0	2
21						261.2	281.8	302.5	323.2	343.8	364.5	385.1	405.8	426.5	447.1	1
22						289.4	312.1	334.7	357.4	380.1	402.8	425.4	448.1	470.8	493.5	3
23						318.9	343.7	368.5	393.3	418.0	442.8	467.6	492.4	517.2	542.0	
24						349.7	376.7	403.7	430.7	457.7	484.7	511.6	538.6	565.6	592.6	
25						381.9	411.2	440.4	469.7	499.0	528.3	557.6	586.8	616.1	645.4	1
26						415.3	447.0	478.7	510.3	542.0	573.7	605.3	637.0	668.7	700.4	
27						450.1	484.2	518.4	552.5	586.7	620.9	655.0	689.2	723.3	757.5	
															Total	42

[a] Weighted regression: BFV = -28.0674 * 0.00937 * d^2h; increased efficiency = 147 percent; standard error of estimate = 27.3 board feet or 16 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9-5 inches in diameter.

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data is shaded. Includes 42 black cottonwood.

Table 4—Board-foot volumes, Scribner rule (1-foot stump to 6-inch top dib) given dbh and height to a usable top for white spruce and black spruce, Susitna River basin, Alaska[a]

DBH (d)[b]	Height to a 6-inch top dib in feet (h)[c]															Trees measured[d]	
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	White spruce	Black spruce
Inches	Board-foot volume															--Number--	
6	1.3	2.8	4.3	5.8	7.4	9.0	10.5									1	1
7	1.9	3.9	6.0	8.1	10.2	12.4	14.6	16.8	19.0							4	2
8	2.5	5.2	7.9	10.7	13.6	16.4	19.4	22.3	25.2							23	8
9	3.2	6.6	10.1	13.7	17.4	21.1	24.8	28.6	32.4	36.2	40.0					40	5
10	4.0	8.3	12.7	17.2	21.7	26.3	31.0	35.7	40.4	45.2	50.0					34	3
11	4.9	10.1	15.5	21.0	26.6	32.2	37.9	43.7	49.5	55.3	61.1	67.0				22	4
12	5.8	12.1	18.6	25.2	31.9	38.7	45.6	52.5	59.4	66.4	73.5	80.5	87.6	94.8	101.9	31	1
13	6.9	14.4	22.1	29.9	37.8	45.9	54.0	62.1	70.4	78.7	87.0	95.4	103.8	112.2	120.7	14	2
14		16.8	25.8	35.0	44.2	53.6	63.1	72.7	82.3	92.0	101.7	111.5	121.4	131.2	141.2	14	1
15			29.8	40.4	51.2	62.0	73.0	84.1	95.2	106.4	117.7	129.0	140.4	151.8	163.3	8	
16			34.2	46.3	58.7	71.1	83.7	96.4	109.1	122.0	134.9	147.9	160.9	174.0	187.2	8	
17			38.9	52.7	66.7	80.8	95.1	109.5	124.0	138.6	153.3	168.1	182.9	197.8	212.7	4	
18			43.9	59.4	75.2	91.2	107.3	123.6	140.0	156.4	173.0	189.6	206.4	223.2	240.0	4	
19						102.2	120.3	138.5	156.9	175.4	193.9	212.6	231.3	250.2	269.1		
20							134.1	154.4	174.8	195.4	216.1	236.9	257.8	278.8	299.9		
21									193.8	216.6	239.6	262.6	285.8	309.1	332.4		
22										239.0	264.3	289.8	315.3	341.0	366.8		
23										262.5	290.3	318.3	346.4	374.6	402.9		
24										287.2	317.6	348.2	378.9	409.8	440.8		
25										313.1	346.3	379.6	413.1	446.7	480.5	1	
26										340.1	376.2	412.4	448.8	485.3	522.0		
27										368.4	407.4	446.6	486.0	525.6	565.3		
															Total	208	27

[a] Regression: $BFV = 0.005601 * (d^2h)^{1.05619}$; increased efficiency = 171 percent; standard error of estimate = 6.4 board feet or 16 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data is shaded. Includes 208 white spruce and 27 black spruce.

Table. 5—Board-foot volumes, Scribner rule (1-foot stump to 6-inch top dib) given dbh and height to a usable top for paper birch and quacking aspen, Susitna River basin, Alaska[a]

DBH (d)[b]	Height to a 6-inch top dib in feet (h)[c]													Trees measured[d]	
	5	10	15	20	25	30	35	40	45	50	55	60	65	Paper birch	Quaking aspen
Inches	Board-foot volume													--Number--	
6	1.8	3.7	5.6	7.5	9.4	11.4	13.3	15.3						1	
7	2.5	5.0	7.7	10.3	12.9	15.6	18.3	20.9	23.6	26.3	29.0	31.7		4	1
8	3.3	6.6	10.1	13.5	17.0	20.5	24.0	27.5	31.1	34.6	38.2	41.7		14	4
9	4.2	8.5	12.8	17.2	21.6	26.1	30.6	35.1	39.6	44.1	48.6	53.1		5	2
10	5.2	10.5	15.9	21.4	26.9	32.4	38.0	43.5	49.1	54.7	60.3	66.0	71.6	16	
11	6.3	12.8	19.3	26.0	32.7	39.4	46.2	52.9	59.7	66.5	73.4	80.2	87.1	12	2
12	7.5	15.3	23.1	31.1	39.1	47.1	55.2	63.3	71.4	79.6	87.7	95.9	104.1	14	3
13	8.8	18.0	27.3	36.6	46.0	55.5	65.0	74.6	84.2	93.8	103.4	113.0	122.7	7	1
14	10.3	20.9	31.7	42.6	53.6	64.6	75.7	86.8	98.0	109.2	120.4	131.6	142.9	3	
15				49.1	61.8	74.5	87.2	100.0	112.9	125.8	138.7	151.6	164.6	4	
16					70.5	85.0	99.6	114.2	128.9	143.6	158.3	173.1	187.9		
17					79.8	96.3	112.8	129.3	145.9	162.6	179.3	196.0	212.8	2	
18					89.8	108.2	126.8	145.4	164.1	182.8	201.6	220.4	239.3	1	
19					100.3	120.9	141.7	162.5	183.3	204.3	225.3	246.3	267.4		
20					111.4	134.4	157.4	180.5	203.7	227.0	250.3	273.6	297.1	1	
21								199.5	225.2	250.9	276.6	302.5	328.4		
22								219.5	247.7	276.0	304.3	332.8	361.4		
													Total	84	13

a Regression: $BFV = 0.008764 \, (d^2 h)^{1.02609}$; increased efficiency = 119 percent; standard error of estimate = 8.3 board feet or 18 percent of the mean volume,

b For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter,

c For example, 60-foot class includes trees 57.6 to 62.5 feet tall,

d Number of trees; range of data is shaded. Includes *84* paper birch and 13 quaking aspen.

Table 6—Board-foot volume (1-foot stump to 6-inch top dib) given dbh and height to a usable top for black cottonwood, Susitna River basin, Alaska[3]

DBH (d)[b]	Height to a 6-inch top dib in feet (h)[c]																	Trees measured[d]
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	Black Cottonwood
Inches	Board-foot volume																	--Number--
6	3.0	5.0	6.9	8.9	10.9	12.8	14.8	16.8										
7	5.1	7.8	10.5	13.2	15.8	18.5	21.2	23.9	26.6	29.2								1
8	7.6	11.1	14.6	18.1	21.6	25.1	28.6	32.1	35.6	39.1								4
9	10.4	14.8	19.2	23.7	28.1	32.5	37.0	41.4	45.8	50.3	54.7	59.1						1
10	13.5	19.0	24.4	29.9	35.4	40.8	46.3	51.8	57.3	62.7	68.2	73.7						1
11	16.9	23.6	30.2	36.8	43.4	50.0	56.7	63.3	69.9	76.5	83.1	89.7						7
12	20.7	28.6	36.5	44.3	52.2	60.1	68.0	75.9	83.7	91.6	99.5	107.4	115.2	123.1	131.0			2
13	24.8	34.1	43.3	52.6	61.8	71.0	80.3	89.5	98.8	108.0	117.3	126.5	135.8	145.0	154.2	163.5	172.7	
14	29.2	40.0	50.7	61.4	72.1	82.9	93.6	104.3	115.0	125.7	136.5	147.2	157.9	168.6	179.3	190.1	200.8	3
15		46.3	58.6	70.9	83.2	95.5	107.9	120.2	132.5	144.8	157.1	169.4	181.7	194.0	206.3	218.6	230.9	6
16		53.1	67.1	81.1	95.1	109.1	123.1	137.1	151.1	165.1	179.1	193.1	207.1	221.1	235.1	249.1	263.1	2
17		60.3	76.1	91.9	107.7	123.6	139.4	155.2	171.0	186.8	202.6	218.4	234.2	250.0	265.8	281.6	297.4	4
18						138.9	156.6	174.3	192.0	209.8	227.5	245.2	262.9	280.7	298.4	316.1	333.8	2
19						155.1	174.8	194.6	214.3	234.0	253.8	273.5	293.3	313.0	332.8	352.5	372.3	2
20							194.0	215.9	237.8	259.6	281.5	303.4	325.3	347.2	369.0	390.9	412.8	2
21								238.3	262.4	286.6	310.7	334.8	358.9	383.0	407.2	431.3	455.4	1
22								261.8	288.3	314.8	341.3	367.7	394.2	420.7	447.2	473.6	500.1	3
23								286.4	315.4	344.3	373.3	402.2	431.1	460.1	489.0	517.9	546.9	
24								312.2	343.7	375.2	406.7	438.2	469.7	501.2	532.7	564.2	595.7	
25								339.0	373.1	407.3	441.5	475.7	509.9	544.1	578.3	612.5	646.6	1
26								366.9	403.8	440.8	477.8	514.8	551.7	588.7	625.7	662.7	699.7	
27								395.8	435.7	475.6	515.5	555.4	595.2	635.1	675.0	714.9	754.7	
																Total		42

[a] Weighted regression: BFV = -2.91379 + 0.01094 • d^2h; increased efficiency = 170 percent; standard error of estimate = 22.2 board feet or 13 percent of the mean volume,

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter,

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall,

[d] Number of trees; range of data is shaded. Includes 42 black cottonwood.

Table 7—Merchantable cubic-foot volume (1-foot stump to 4-inch top dib) given dbh and total height, Smalian's formula, for white spruce and black spruce, Susitna River basin, Alaska[a]

DBH (d)[b]	Total height in feet (h)[c]															Trees measured[d]	
	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	White spruce	Black spruce
Inches	Cubic-foot volume															--Number--	
5	0.7	1.0	1.2	1.4	1.7	1.9	2.1	2.4	2.6	2.9						7	1
6	1.1	1.5	1.8	2.2	2.5	2.8	3.2	3.5	3.9	4.2	4.5					19	9
7	1.6	2.1	2.6	3.0	3.5	3.9	4.4	4.9	5.3	5.8	6.3	6.7	7.2			12	9
8	2.2	2.8	3.4	4.0	4.6	5.2	5.8	6.4	7.0	7.6	8.2	8.9	9.5			26	8
9	2.8	3.6	4.4	5.1	5.9	6.7	7.4	8.2	9.0	9.7	10.5	11.3	12.0			40	5
10	3.6	4.5	5.5	6.4	7.3	8.3	9.2	10.2	11.1	12.1	13.0	14.0	14.9			34	3
11		5.5	6.6	7.8	8.9	10.1	11.2	12.4	13.5	14.6	15.8	16.9	18.1	19.2		22	4
12		6.6	7.9	9.3	10.7	12.0	13.4	14.8	16.1	17.5	18.8	20.2	21.6	22.9	24.3	31	1
13		7.8	9.4	11.0	12.6	14.2	15.8	17.3	18.9	20.5	22.1	23.7	25.3	26.9	28.5	14	2
14			10.9	12.7	14.6	16.5	18.3	20.2	22.0	23.9	25.7	27.6	29.4	31.3	33.1	14	1
15			12.5	14.7	16.8	18.9	21.0	23.2	25.3	27.4	29.5	31.7	33.8	35.9	38.1	8	
16			14.3	16.7	19.1	21.6	24.0	26.4	28.8	31.2	33.7	36.1	38.5	40.9	43.3	8	
17			16.2	18.9	21.6	24.4	27.1	29.8	32.6	35.3	38.0	40.7	43.5	46.2	48.9	4	
18				21.2	24.3	27.3	30.4	33.5	36.5	39.6	42.6	45.7	48.8	51.8	54.9	4	
19							33.9	37.3	40.7	44.1	47.5	51.0	54.4	57.8	61.2		
20									45.1	48.9	52.7	56.5	60.3	64.0	67.8		
21										54.0	58.1	62.3	66.5	70.6	74.8		
22										59.2	63.8	68.4	73.0	77.5	82.1		
23											69.8	74.8	79.8	84.8	89.8		
24											76.0	81.4	86.9	92.3	97.8		
25											82.5	88.4	94.3	100.2	106.1	1	
26											89.2	95.6	102.0	108.4	114.8		
27											96.2	103.1	110.0	116.9	123.8		
															Total	244	43

a Weighted regression: CFV = -0.21849 * 0.00189 * d^2h; increased efficiency = 136 percent; standard error of estimate = 1.4 cubic feet or 13 percent of the mean volume,

b For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter,

c For example, 60-foot class includes trees 57.6 to 62.5 feet tall,

d Number of trees; range of data is shaded. Includes 244 white spruce and 43 black spruce.

Table 8—Merchantable cubic-foot volume (1-foot stump to 4-inch top dib) given dbh and total height, Smalian's formula, for paper birch and quaking aspen, Susitna River basin, Alaska[a]

DBH (d)[b]	Total height in feet (h)[c]												Trees measured[d]	
	25	30	35	40	45	50	55	60	65	70	75	80	Paper birch	Quaking aspen
Inches	Cubic-foot volume												--Number--	
5	.6	.9	1.1	1.4	1.7	1.9	2.2	2.5	2.7	3.0	3.2		3	
6	1.2	1.6	1.9	2.3	2.7	3.1	3.5	3.8	4.2	4.6	5.0		5	1
7	1.9	2.4	2.9	3.4	3.9	4.5	5.0	5.5	6.0	6.5	7.0		8	1
8	2.7	3.3	4.0	4.7	5.4	6.0	6.7	7.4	8.1	8.7	9.4		16	4
9	3.6	4.4	5.3	6.1	7.0	7.8	8.7	9.5	10.4	11.3	12.1		5	2
10	4.6	5.6	6.7	7.7	8.8	9.8	10.9	11.9	13.0	14.1	15.1	16.2	16	
11	5.7	6.9	8.2	9.5	10.8	12.1	13.3	14.6	15.9	17.2	18.4	19.7	12	2
12	6.9	8.4	9.9	11.4	13.0	14.5	16.0	17.5	19.0	20.6	22.1	23.6	14	3
13		10.0	11.8	13.6	15.3	17.1	18.9	20.7	22.5	24.2	26.0	27.8	7	1
14			13.8	15.8	17.9	20.0	22.0	24.1	26.2	28.2	30.3	32.4	3	
15				18.3	20.7	23.0	25.4	27.8	30.1	32.5	34.9	37.3	4	
16				20.9	23.6	26.3	29.0	31.7	34.4	37.1	39.8	42.5		
17					26.7	29.8	32.8	35.9	38.9	42.0	45.0.	48.1	2	
18					30.1	33.5	36.9	40.3	43.7	47.1	50.6	54.0	1	
19					33.6	37.4	41.2	45.0	48.8	52.6	56.4	60.2		
20					37.3	41.5	45.7	49.9	54.1	58.4	62.6	66.8	1	
21								55.1	59.8	64.4	69.1	73.7		
22								60.6	65.7	70.8	75.9	81.0		
												Total	97	14

[a] Weighted regression: $CFV = -0.71200 + 0.00211 * d^2 h$; increased efficiency = 109 percent; standard error of estimate = 2.0 cubic feet or 16 percent of the mean volume,

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter,

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall,

[d] Number of trees; range of data is shaded. Includes 97 paper birch and 14 quaking aspen.

Table 9—(Merchantable cubic-foot volume (1-foot stump to 4-inch top dib) given dbh and total height, Smalian's formula, for black cottonwood, Susitna River *basin*, Alaska[a]

DBH (d)[b]	Total height in feet (h)[c]															Trees measured[d]
	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Black Cottonwood
Inches	Cubic-foot volume															--Number--
5	.7	1.0	1.2	1.4	1.7	1.9	2.1	2.4	2.6	2.8						
6	1.6	2.0	2.3	2.7	3.0	3.3	3.7	4.0	4.4	4.7	5.0					
7	2.7	3.2	3.7	4.1	4.6	5.1	5.5	6.0	6.4	6.9	7.4	7.8	8.3			2
8	4.0	4.6	5.2	5.8	6.4	7.0	7.6	8.2	8.8	9.4	10.0	10.6	11.2			4
9	5.5	6.2	7.0	7.7	8.5	9.3	10.0	10.8	11.5	12.3	13.1	13.8	14.6			1
10	7.1	8.0	8.9	9.9	10.8	11.8	12.7	13.6	14.6	15.5	16.5	17.4	18.3			1
11	8.8	10.0	11.1	12.3	13.4	14.5	15.7	16.8	17.9	19.1	20.2	21.4	22.5			7
12	10.8	12.1	13.5	14.8	16.2	17.6	18.9	20.3	21.6	23.0	24.3	25.7	27.0			2
13	12.9	14.5	16.1	17.7	19.3	20.8	22.4	24.0	25.6	27.2	28.8	30.4	32.0	33.6	35.1	
14	15.2	17.0	18.9	20.7	22.6	24.4	26.2	28.1	29.9	31.8	33.6	35.5	37.3	39.1	41.0	3
15	17.6	19.8	21.9	24.0	26.1	28.2	30.3	32.4	34.6	36.7	38.8	40.9	43.0	45.1	47.2	6
16	20.3	22.7	25.1	27.5	29.9	32.3	34.7	37.1	39.5	41.9	44.3	46.7	49.1	51.5	53.9	2
17	23.1	25.8	28.5	31.2	33.9	36.6	39.4	42.1	44.8	47.5	50.2	52.9	55.7	58.4	61.1	4
18			32.1	35.1	38.2	41.2	44.3	47.3	50.4	53.4	56.5	59.5	62.6	65.6	68.7	2
19				39.3	42.7	46.1	49.5	52.9	56.3	59.7	63.1	66.5	69.9	73.3	76.7	2
20					47.5	51.2	55.0	58.8	62.5	66.3	70.0	73.8	77.6	81.3	85.1	2
21						56.6	60.8	64.9	69.1	73.2	77.4	81.5	85.7	89.8	93.9	1
22						62.3	66.8	71.4	75.9	80.5	85.0	89.6	94.1	98.7	103.2	3
23						68.2	73.2	78.2	83.1	88.1	93.1	98.1	103.0	108.0	113.0	
24						74.4	79.8	85.2	90.6	96.1	101.5	106.9	112.3	117.7	123.1	
25						80.9	86.7	92.6	98.5	104.4	110.2	116.1	122.0	127.9	133.7	1
26						87.6	93.9	100.3	106.6	113.0	119.3	125.7	132.0	138.4	144.8	
27						94.5	101.4	108.2	115.1	121.9	128.8	135.7	142.5	149.4	156.2	
														Total		43

[a] Weighted regression: CFV = -1-39764 + 0.00188 ° d h; increased efficiency = 138 percent; standard error of estimate = 4.1 cubic feet or 11 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall,

[d] Number of trees; range of data is shaded. Includes 43 black cottonwood.

Table 10—Merchantable cubic-foot volume (1-foot stump to 4-inch top dib) given dbh and height to a usable top, Smalian's formula, for white spruce and black spruce, Susitna River basin, Alaska[a]

DBH (d)[b]	Height to a 4-inch top dib in feet[c]															Trees measured[d]	
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	White spruce	Black spruce
Inches	Cubic-foot volume															--Number--	
5	1.1	1.4	1.7	2.0	2.3	2.6	2.9									7	1
6	1.4	1.8	2.3	2.7	3.1	3.6	4.0	4.5	4.9							19	9
7	1.7	2.3	2.9	3.5	4.1	4.7	5.3	5.9	6.5	7.1	7.7					12	9
8	2.1	2.9	3.6	4.4	5.2	6.0	6.7	7.5	8.3	9.1	9.9					26	8
9	2.5	3.5	4.5	5.4	6.4	7.4	8.4	9.4	10.4	11.3	12.3					40	5
10	2.9	4.2	5.4	6.6	7.8	9.0	10.2	11.5	12.7	13.9	15.1	16.3				34	3
11	3.5	4.9	6.4	7.9	9.3	10.8	12.3	13.8	15.2	16.7	18.2	19.6	21.1			22	4
12	4.0	5.8	7.5	9.3	11.0	12.8	14.5	16.3	18.0	19.8	21.5	23.3	25.0	26.8	28.5	31	1
13		6.7	8.7	10.8	12.8	14.9	16.9	19.0	21.1	23.1	25.2	27.2	29.3	31.3	33.4	14	2
14			10.0	12.4	14.8	17.2	19.6	22.0	24.3	26.7	29.1	31.5	33.9	36.2	38.6	14	1
15			11.5	14.2	16.9	19.7	22.4	25.1	27.9	30.6	33.3	36.1	38.8	41.5	44.3	8	
16			13.0	16.1	19.2	22.3	25.4	28.5	31.6	34.7	37.8	41.0	44.1	47.2	50.3	8	
17			14.6	18.1	21.6	25.1	28.6	32.1	35.6	39.1	42.7	46.2	49.7	53.2	56.7	4	
18			16.3	20.2	24.1	28.1	32.0	35.9	39.9	43.8	47.8	51.7	55.6	59.6	63.5	4	
19						31.2	35.6	40.0	44.4	48.8	53.2	57.5	61.9	66.3	70.7		
20								44.3	49.1	54.0	58.8	63.7	68.6	73.4	78.3		
21									54.1	59.5	64.8	70.2	75.5	80.9	86.2		
22									59.3	65.2	71.1	77.0	82.8	88.7	94.6		
23										71.2	77.6	84.1	90.5	96.9	103.4		
24										77.5	84.5	91.5	98.5	105.5	112.5		
25											91.6	99.2	106.8	114.4	122.0	1	
26											99.1	107.3	115.5	123.7	131.9		
27											106.8	115.7	124.5	133.4	142.2		
															Total	244	43

a Weighted regression: CFV = 0.519^3 + 0.00243 * d h; increased efficiency = 117 percent; standard error of estimate = 1.3 cubic feet or 12 percent of the mean volume.

b For example, 9-inch class includes trees 8.6 to 9-5 inches in diameter.

c For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

d Number of trees; range of data is shaded. Includes *244* white spruce and 43 black spruce.

Table 11—Merchantable cubic-foot volume (1-foot stump to 4-inch top dib) given dbh and height to a usable top, Smalian's formula, for paper birch and quaking aspen, Susitna River basin, Alaska[a]

DBH (d)[b]	Height to a 4-inch top dib in feet[c]														Trees measured[d]	
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	Paper birch	Quaking aspen
Inches	Cubic-foot volume														--Number--	
5	.8	1.2	1.5	1.9	2.2	2.6	2.9	3.3	3.6						3	
6	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5					5	1
7	1.2	1.8	2.5	3.2	3.9	4.6	5.2	5.9	6.6	7.3					8	1
8	1.4	2.3	3.1	4.0	4.9	5.8	6.7	7.6	8.5	9.4	10.3	11.2			16	4
9	1.6	2.7	3.9	5.0	6.1	7.2	8.4	9.5	10.6	11.7	12.9	14.0	15.1		5	2
10	1.9	3.3	4.6	6.0	7.4	8.8	10.2	11.6	13.0	14.4	15.8	17.2	18.5	19.9	16	
11			5.5	7.2	8.9	10.6	12.3	13.9	15.6	17.3	19.0	20.7	22.3	24.0	12	2
12			6.5	8.5	10.5	12.5	14.5	16.5	18.5	20.5	22.5	24.5	26.5	28.5	14	3
13			7.5	9.9	12.2	14.6	16.9	19.3	21.6	24.0	26.3	28.7	31.0	33.4	7	1
14			8.7	11.4	14.1	16.8	19.5	22.3	25.0	27.7	30.4	33.2	35.9	38.6	3	
15					16.1	19.2	22.4	25.5	28.6	31.8	34.9	38.0	41.1	44.3	4	
16					18.3	21.8	25.4	28.9	32.5	36.1	39.6	43.2	46.7	50.3		
17					20.6	24.6	28.6	32.6	36.6	40.6	44.7	48.7	52.7	56.7	2	
18					23.0	27.5	32.0	36.5	41.0	45.5	50.0	54.5	59.0	63.5	1	
19					25.6	30.6	35.6	40.6	45.6	50.7	55.7	60.7	65.7	70.7		
20					28.3	33.8	39.4	45.0	50.5	56.1	61.6	67.2	72.8	78.3	1	
21									55.6	61.8	67.9	74.0	80.2	86.3		
22									61.0	67.8	74.5	81.2	87.9	94.7		
														Total	97	14

a Weighted regression: CFV = O.A786O + 0.00278 ^{0} d^2 h; increased efficiency = 106 percent; standard error of estimate =1.9 cubic feet or 15 percent of the mean volume.

b For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

c For example. 60-foot class includes trees 57-6 to 62.5 feet tall.

d Number of trees; range of data is shaded. Includes 97 paper birch and 14 quaking aspen.

Table 12—Merchantable cubic-foot volume (1-foot stump to 4-inch top dib) given dbh and height to a usable top, Smalian's formula, for black cottonwood, Susitna River basin, Alaska[a]

DBH (d)[b]	Height to a 4-inch top dib in feet[c]															Trees measured[d]
	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	Black Cottonwood
Inches	Cubic-foot volume															--Number--
5	2.8	3.1	3.3	3.6	3.9	4.1	4.4	4.6								
6	3.5	3.9	4.3	4.6	5.0	5.4	5.8	6.2	6.5							
7	4.3	4.8	5.3	5.9	6.4	6.9	7.4	7.9	8.5	9.0	9.5					2
8	5.3	5.9	6.6	7.3	8.0	8.6	9.3	10.0	10.7	11.3	12.0					4
9	6.3	7.2	8.1	8.9	9.8	10.6	11.5	12.3	13.2	14.0	14.9	15.7	16.6			1
10	7.5	8.6	9.7	10.7	11.8	12.8	13.9	14.9	16.0	17.0	18.1	19.1	20.2			1
11	8.9	10.1	11.4	12.7	14.0	15.3	16.5	17.8	19.1	20.4	21.6	22.9	24.2			7
12	10.3	11.8	13.4	14.9	16.4	17.9	19.4	21.0	22.5	24.0	25.5	27.0	28.6	30.1		2
13	11.9	13.7	15.5	17.3	19.0	20.8	22.6	24.4	26.2	28.0	29.7	31.5	33.3	35.1	36.9	
14	13.6	15.7	17.8	19.8	21.9	24.0	26.0	28.1	30.2	32.2	34.3	36.4	38.4	40.5	42.6	3
15	15.5	17.8	20.2	22.6	25.0	27.3	29.7	32.1	34.4	36.8	39.2	41.6	43.9	46.3	48.7	6
16	17.4	20.1	22.8	25.5	28.2	30.9	33.6	36.3	39.0	41.7	44.4	47.1	49.8	52.5	55.2	2
17	19.5	22.6	25.6	28.7	31.7	34.8	37.8	40.9	43.9	46.9	50.0	53.0	56.1	59.1	62.2	4
18				32.0	35.4	38.8	42.2	45.7	49.1	52.5	55.9	59.3	62.7	66.2	69.6	2
19					39.3	43.1	46.9	50.7	54.5	58.3	62.2	66.0	69.8	73.6	77.4	2
20					43.4	47.6	51.9	56.1	60.3	64.5	68.7	73.0	77.2	81.4	85.6	2
21						52.4	57.0	61.7	66.3	71.0	75.7	80.3	85.0	89.6	94.3	1
22						57.4	62.5	67.6	72.7	77.8	82.9	88.0	93.1	98.2	103.3	3
23						62.6	68.2	73.8	79.3	84.9	90.5	96.1	101.7	107.3	112.8	
24						68.1	74.1	80.2	86.3	92.4	98.4	104.5	110.6	116.7	122.7	
25						73.7	80.3	86.9	93.5	100.1	106.7	113.3	119.9	126.5	133.1	1
26						79.7	86.8	93.9	101.1	108.2	115.3	122.5	129.6	136.7	143.8	
27						85.8	93.5	101.2	108.9	116.6	124.3	132.0	139.7	147.3	155.0	
														Total		43

a Weighted regression: CFV = 1.9987 + 0.00204 * d^2 h; increased efficiency = 131 percent; standard error of estimate = 4.1 cubic feet or 11 percent of the mean volume.

b For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

c For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

d Number of trees; range of data is shaded. Includes 43 black cottonwood.

Table 13 –Total cubic-foot volume (1-foot stump to tree tip) given dbh and total tree height, Smalian's formula, for white spruce and black spruce, "Susitna" River basin, Alaska[a]

DBH (d)[b]	Total height in feet (h)[c]															Trees measured[d]	
	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	White spruce	Black spruce
Inches	Cubic-foot volume															--Number--	
5	1.6	1.8	2.1	2.3	2.6	2.8	3.0	3.3	3.5	3.8						7	1
6	2.0	2.4	2.7	3.1	3.4	3.7	4.1	4.4	4.8	5.1	5.5					19	9
7	2.5	3.0	3.5	3.9	4.4	4.9	5.3	5.8	6.3	6.7	7.2	7.7	8.1			12	9
8	3.1	3.7	4.3	4.9	5.5	6.2	6.8	7.4	8.0	8.6	9.2	9.8	10.4			26	8
9	3.7	4.5	5.3	6.1	6.8	7.6	8.4	9.2	9.9	10.7	11.5	12.3	13.0			40	5
10	4.5	5.4	6.4	7.3	8.3	9.3	10.2	11.2	12.1	13.1	14.0	15.0	15.9			34	3
11		6.4	7.6	8.7	9.9	11.1	12.2	13.4	14.5	15.7	16.8	18.0	19.1	20.3		22	4
12		7.5	8.9	10.3	11.7	13.0	14.4	15.8	17.2	18.5	19.9	21.3	22.7	24.0	25.4	31	1
13		8.7	10.3	12.0	13.6	15.2	16.8	18.4	20.0	21.6	23.3	24.9	26.5	28.1	29.7	14	2
14			11.9	13.8	15.6	17.5	19.4	21.2	23.1	25.0	26.9	28.7	30.6	32.5	34.3	14	1
15			13.5	15.7	17.8	20.0	22.1	24.3	26.4	28.6	30.7	32.9	35.0	37.2	39.3	8	
16			15.3	17.8	20.2	22.7	25.1	27.5	30.0	32.4	34.9	37.3	39.8	42.2	44.7	8	
17			17.2	20.0	22.7	25.5	28.3	31.0	33.8	36.5	39.3	42.1	44.8	47.6	50.3	4	
18				22.3	25.4	28.5	31.6	34.7	37.8	40.9	44.0	47.1	50.2	53.3	56.4	4	
19							35.1	38.6	42.0	45.5	48.9	52.4	55.8	59.3	62.7		
20									46.5	50.3	54.1	58.0	61.8	65.6	69.4		
21										55.4	59.6	63.8	68.0	72.3	76.5		
22										60.7	65.4	70.0	74.6	79.2	83.9		
23											71.4	76.4	81.5	86.5	91.6		
24											77.7	83.2	88.7	94.2	99.7		
25											84.2	90.2	96.2	102.1	108.1	1	
26											91.0	97.5	103.9	110.4	116.9		
27											98.1	105.1	112.0	119.0	126.0		
															Total	244	43

a Weighted regression: CFV = 0.65559 + 0.00191 ° d h; increased efficiency = 137 percent; standard error of estimate = 1.4 cubic feet or 11 percent of the mean volume.

b For example, 9-inch class includes trees 8.6 to 9-5 inches in diameter.

c For example, 60-foot class includes trees 57-6 to 62.5 feet tall.

d Number of trees; range of data is shaded. Includes *2kk* white spruce and 43 black spruce.

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Table 14—Total cubic-foot volume (1-foot stump to tree tip) given dbh and total tree height, Smalian's formula, for paper birch and quaking aspen, Susitna River basin, Alaska[a]

DBH[b] (d)	Total height in feet (h)[c]												Trees measured[d]	
	25	30	35	40	45	50	55	60	65	70	75	80	Paper birch	Quaking aspen
Inches	Cubic-foot volume												--Number--	
5	1.9	2.2	2.4	2.7	3.0	3.2	3.5	3.7	4.0	4.2	4.5		3	
6	2.5	2.9	3.2	3.6	4.0	4.4	4.7	5.1	5.5	5.8	6.2		5	1
7	3.2	3.7	4.2	4.7	5.2	5.7	6.2	6.7	7.2	7.7	8.2		8	1
8	3.9	4.6	5.3	5.9	6.6	7.2	7.9	8.6	9.2	9.9	10.5		16	4
9	4.8	5.7	6.5	7.3	8.2	9.0	9.8	10.7	11.5	12.3	13.2		5	2
10	5.8	6.8	7.9	8.9	9.9	10.9	12.0	13.0	14.0	15.1	16.1	17.1	16	
11	6.9	8.1	9.4	10.6	11.9	13.1	14.4	15.6	16.8	18.1	19.3	20.6	12	2
12	8.1	9.5	11.0	12.5	14.0	15.5	17.0	18.4	19.9	21.4	22.9	24.4	14	3
13		11.1	12.8	14.6	16.3	18.1	19.8	21.5	23.3	25.0	26.8	28.5	7	1
14			14.8	16.8	18.8	20.8	22.9	24.9	26.9	28.9	30.9	32.9	3	
15				19.2	21.5	23.8	26.1	28.5	30.8	33.1	35.4	37.7	4	
16				21.7	24.4	27.0	29.6	32.3	34.9	37.6	40.2	42.8		
17					27.4	30.4	33.4	36.4	39.3	42.3	45.3	48.3	2	
18					30.7	34.0	37.4	40.7	44.0	47.4	50.7	54.0	1	
19					34.1	37.8	41.5	45.3	49.0	52.7	56.4	60.1		
20					37.7	41.8	46.0	50.1	54.2	58.3	62.4	66.6	1	
21								55.2	59.7	64.2	68.8	73.3		
22								60.5	65.5	70.4	75.4	80.4		
												Total	97	14

[a] Weighted regression: $CFV = 0.6M56 + 0.00206 \cdot d^2h$; increased efficiency = 113 percent; standard error of estimate = 1.8 cubic feet or 13 percent of the mean volume,

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter,

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall,

[d] Number of trees; range of data is shaded. Includes 97 paper birch and 14 quaking aspen.

Table 15—Total cubic-foot volume (1-foot stump to tree tip) given dbh and total tree height, Smalian's formula, for black cottonwood, Susitna River basin Alask[a]

DBH (d)[b]	Total height in feet (h)[c]															Trees measured[d]
	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Black Cottonwood
Inches	Cubic-foot volume															--Number--
5	3.0	3.2	3.5	3.7	3.9	4.2	4.4	4.6	4.8	5.1						
6	3.9	4.2	4.6	4.9	5.2	5.5	5.9	6.2	6.5	6.9	7.2					
7	5.0	5.4	5.9	6.3	6.8	7.2	7.6	8.1	8.5	9.0	9.4	9.9	10.3			2
8	6.2	6.8	7.4	7.9	8.5	9.1	9.7	10.3	10.8	11.4	12.0	12.6	13.1			4
9	7.6	8.3	9.0	9.8	10.5	11.2	12.0	12.7	13.4	14.2	14.9	15.6	16.4			1
10	9.1	10.0	10.9	11.8	12.8	13.7	14.6	15.5	16.4	17.3	18.2	19.1	20.0			1
11	10.8	11.9	13.0	14.1	15.2	16.3	17.4	18.5	19.6	20.7	21.8	22.9	24.0			7
12	12.7	14.0	15.3	16.6	17.9	19.2	20.5	21.8	23.1	24.4	25.7	27.1	28.4			2
13	14.8	16.3	17.8	19.3	20.9	22.4	23.9	25.5	27.0	28.5	30.0	31.6	33.1	34.6	36.2	
14	17.0	18.7	20.5	22.3	24.0	25.8	27.6	29.4	31.1	32.9	34.7	36.5	38.2	40.0	41.8	3
15	19.3	21.3	23.4	25.4	27.5	29.5	31.5	33.6	35.6	37.6	39.7	41.7	43.7	45.8	47.8	6
16	21.8	24.2	26.5	28.8	31.1	33.4	35.7	38.1	40.4	42.7	45.0	47.3	49.6	52.0	54.3	2
17	24.5	27.1	29.8	32.4	35.0	37.6	40.2	42.8	45.4	48.1	50.7	53.3	55.9	58.5	61.1	4
18				36.2	39.1	42.0	45.0	47.9	50.8	53.8	56.7	59.6	62.6	65.5	68.4	2
19					43.5	46.7	50.0	53.3	56.5	59.8	63.1	66.3	69.6	72.9	76.1	2
20					48.0	51.7	55.3	58.9	62.5	66.1	69.8	73.4	77.0	80.6	84.2	2
21						56.9	60.9	64.8	68.8	72.8	76.8	80.8	84.8	88.8	92.8	1
22						62.3	66.7	71.1	75.4	79.8	84.2	88.6	93.0	97.4	101.7	3
23						68.0	72.8	77.6	82.4	87.2	91.9	96.7	101.5	106.3	111.1	
24						74.0	79.2	84.4	89.6	94.8	100.0	105.2	110.5	115.7	120.9	
25						80.2	85.8	91.5	97.1	102.8	108.5	114.1	119.8	125.4	131.1	1
26						86.6	92.8	98.9	105.0	111.1	117.2	123.3	129.5	135.6	141.7	
27						93.4	99.9	106.5	113.1	119.7	126.3	132.9	139.5	146.1	152.7	
														Total		43

a Weighted regression: CFV = 0.98640 +0.00181 ° d^2h; increased efficiency = 138 percent; standard error of estimate = *k*.2 cubic feet or 11 percent of the mean volume.

b For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

c For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

d Number of trees; range of data is shaded. Includes 43 black cottonwood.

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